REMARKS

This response is submitted in reply to the Office Action dated February 13, 2003. Claims 1, 3, 4, 6, 8, 9 and 11-22 are pending in the patent application. Claims 23-30 have been added. The Office Action rejects claims 1, 3, 4, 6, 8, 9 and 11-22 under 35 U.S.C. § 103. No new matter has been added by any of the amendments made herein. Applicants respectfully submit, for the reasons set forth below, that the rejections have been overcome or are improper. Accordingly, Applicants respectfully request reconsideration of the patentability of claims 1, 3, 4, 6, 8, 9 and 11-22.

Claims 1, 3, 4, 6, 8, 9 and 11-22 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 4,807,153 to Onaga et al. ("*Onaga*") in view of U.S. Patent No. 5,245,263 to Tsai et al. ("*Tsai*"), U.S. Patent No. 6,222,338 to Villaret ("*Villaret*") and U.S. Patent No. 6,064,167 to Takenaka et al. ("*Takenaka*"). For the following reasons, Applicants submit that the combination of *Onaga*, *Tsai*, *Villaret* and *Takenaka* does not teach or suggest the invention of claims 1, 3, 4, 6, 8, 9 and 11-22, and therefore, Applicants respectfully request that the patentability of these claims be reconsidered.

In order to combine references under 35 U.S.C. §103 there must be some teaching or suggestion within the references themselves or with the general knowledge available to those of ordinary skill in the art which would lead one skilled in the art to combine the teaching of the references in question. In the present case there is no such teaching or suggestion which would have led a person of ordinary skill in the art to combine the teachings of *Onaga*, *Tsai, Villaret* and *Takenaka* to arrive at the invention claimed in the present application.

In the present application, each of the independent claims 1, 4, 6, 9, 11, 13, 14, 16, 18, 19, 20 and 22 calls for either a joint control apparatus, robot apparatus, robot device or robot device control method for controlling the movement of a robot joint including an actuator. Each actuator includes an electric current detector for detecting a drive current of the actuator; torque detector for detecting the amount of torque based on the drive current detected by the electric current detector; and controller for controlling the actuator based on the amount of torque detected by the torque detector. Each of the electric current detectors, the torque detectors and the controllers are to be included in the actuator. This feature substantially reduces the amount

of wiring in the joint and simplifies the overall joint design. Each of the method claims calls for, among other things, a method for controlling the movement of a robot joint including the steps of detecting the drive current of an actuator using an electric current detector included in the actuator; detecting an amount of torque based on the drive current detected by the electric current detector using torque detector included in the actuator; and controlling the actuator using controller based on the amount of detected torque.

On the contrary, *Onaga* teaches a backup velocity monitor and protection system in a robot control system. The controls for controlling robot joints are typically controlled with a velocity control loop configuration that includes a velocity control for each joint motor. The velocity control loop uses joint motor velocity feedback usually generated by a sensor such as a tachometer to control the movements of the joints. If the tachometer becomes defective or if the velocity feedback information signal is erroneous or lost, the control of the particular robot joint is essentially lost. The resultant arm motion due to the erroneous movement of the joint may lead to injury or damage of products or property.

In particular, the control system is a multi-axis digital robot control which utilizes a torque processor board 600, a servo control board 400 and an AIF board 800 to provide six complete control of all of the robot joints in the robot arm. The backup velocity monitoring system independently monitors and determines the velocity of each joint motor from the electric current, terminal voltage and the motor inductance and resistance controlled by the above boards. As shown in Figs. 3 and 4, the robot arm dependent hardware and independent robot controls described above are external to the robot 20. The system therefore makes comparisons between the primary and backup velocity signals for each joint motor using controls that are independent from the motors to identify any defective, erroneous or lost velocity feedback signals. If defective or erroneous velocity feedback signals are discovered, the backup mechanism provides the appropriate protective action.

Onaga is therefore concerned with providing a backup system that identifies defective and/or erroneous velocity feedback information from one or more joint motors to minimize and/or prevent undesirable joint movements in a robot, and is not concerned with reducing the complexity of the wiring of the robot or improving the mobility of the robot. The Patent Office

agrees that *Onaga* does not disclose, teach or suggest, providing a joint control such as an actuator which includes an electric current detection device, a torque detection device and a control device (see the Office Action, page 5, lines 12-16).

The Patent Office cites *Tsai* to remedy the deficiencies of *Onaga*. Specifically, the Patent Office alleges that *Tsai* discloses an actuator which includes control means, current detectors and torque detectors as in the claimed invention (see the Office Action, page 5, lines 17-19). On the contrary, *Tsai* does not disclose, teach or suggest such elements.

Tsai discloses a system for controlling backlash in gear-coupled transmission mechanisms. The system uses redundant unidirectional drives to continuously assure positive coupling of meshing gears in multiple Degrees Of Freedom (DOF) transmission systems. In particular, the system includes a closed loop controller including adaptive anti-backlash torque command means where the gears are always positively engaged in an operational state because the torque generated by the input drive devices of the gears is unidirectional. As shown in Fig. 10, the controller is independent of the backlash system (Col. 9, lines 17-21). The controller receives feedback signals from sensors on the actuators and then computes and generates the required torque command signals (i.e., "torque command" in Fig.10) to the actuators. (Col. 9, lines 11-17). *Tsai* is therefore concerned with preventing backlash in devices having multiple degrees of freedom such as gear-driven machines and other similar devices using a controller which is independent and separate from the actuators in the system. Thus, *Tsai* does not teach or suggest an actuator for controlling a robot joint that includes an electric current detection device, a torque detection device and a control device *in the actuator itself* for controlling the operation of the actuator.

Moreover, the teachings of *Onaga* are totally unrelated to the teachings of *Tsai*. In particular, one of ordinary skill in the art interested in developing a backup system to monitor the validity of a velocity feedback signal generated by servo-motors associated with robotic joints as taught by *Onaga*, would not have been motivated to employ the unidirectional torque method taught by *Tsai*. Furthermore, *Onaga* does not disclose, nor teach or suggest, that backlash is a problem in their joint mechanisms. In fact, employing an anti-backlash drive system or similar system is irrelevant to the problem addressed by *Onaga*. Therefore, one of ordinary skill in the

art would not have considered the *Tsai* reference useful in solving the problems in *Onaga*. In fact, neither reference is particularly relevant to solve the problem of reducing the amount of complex wiring in the joints to improve the durability and mobility of the robot devices as solved by the claimed invention. Conversely, both references disclose complex control systems which inherently include complex wiring configurations.

The Patent Office adds *Villaret* and *Takenaka* to further clarify components allegedly disclosed by the combination of *Onaga* and *Tsai*. Specifically, the Patent Office alleges that *Villaret* discloses torque detectors, current detectors and an actuator or motor which are included in an "actuator case 31." The reference numeral 31, however, refers to servo controller 31 and reference numeral 37 refers to the actuator or motor (Col. 6, lines 15-24; Figs. 2-3). The servo controller 31 and the actuator 37 are separate and independent components of the apparatus as illustrated in Figs. 2 and 3. In fact, the servo controller 31 receives an input from the encoder 36 and outputs current values to the motor 37 (Col. 6, lines 23-25). Specifically, the actual torques are outputted to the motors from the servo amplifier 51 and the position values are received from the encoder device 36 (which is not part of the motor 37) (Fig. 3; Col. 6 line 44 to Col. 7, line 9). Thus, the position and torque sensors and control devices are not located in the motor 37 or in the motor housing or case. As a result, *Villaret* does not teach or suggest including such elements in the motor to control the operation of the motor and minimize the wiring associated with a robot joint.

As described above, a person of ordinary skill in the art would not be motivated to combine *Onaga* and *Tsai* where there is not motivation in either reference to perform such a combination. Moreover, due to the lack of any teaching or suggestion in the *Onaga*, *Tsai*, *Villaret* and *Takenaka* references themselves or within the general knowledge of those skilled in the art to combine any of these references, the Patent Office has not met its burden of establishing that the rejected claims are *prima facie* obvious under 35 U.S.C. §103, and the final rejection of claims 1, 3, 4, 6, 8, 9 and 11-22 should be reversed.

New independent claims 23, 25, 27 and 29, and new dependent claims 24, 26, 28 and 30, which depend from these claims respectively, include similar elements to the rejected claims. Therefore, Applicants respectfully submit that new claims 23-30 are allowable for at least the

reasons set forth above with respect to the rejected claims because the combination of *Onaga*, *Tsai*, *Villaret* and *Takenaka* does not disclose, teach or suggest the novel elements described in the new claims. For these reasons, new Claims 23-30 are patentably distinguished over the combination of *Onaga*, *Tsai*, *Villaret* and *Takenaka*.

Applicants respectfully submit that Claims 1, 3, 4, 6, 8, 9, 11-22 and new claims 23-30 are novel and nonobvious over the art of record. For the foregoing reasons, Applicants respectfully request reconsideration of the patentability of these claims and earnestly solicit an early allowance of same.

A check in the amount of $444.00 is enclosed to cover the fees for the newly added claims. If any other fees are due in connection with this application as a whole, the Patent Office is authorized to deduct such fees from Deposit Account 02-1818. If such a withdrawal is made, please indicate the attorney docket number (113298-002) on the account statement.

Respectfully submitted,

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